Sentinel Asia Success Story in the Philippines Status Report

3rd Joint Project Team Meeting for Sentinel Asia STEP-3

(JPTM2016), Colombo, Sri Lanka

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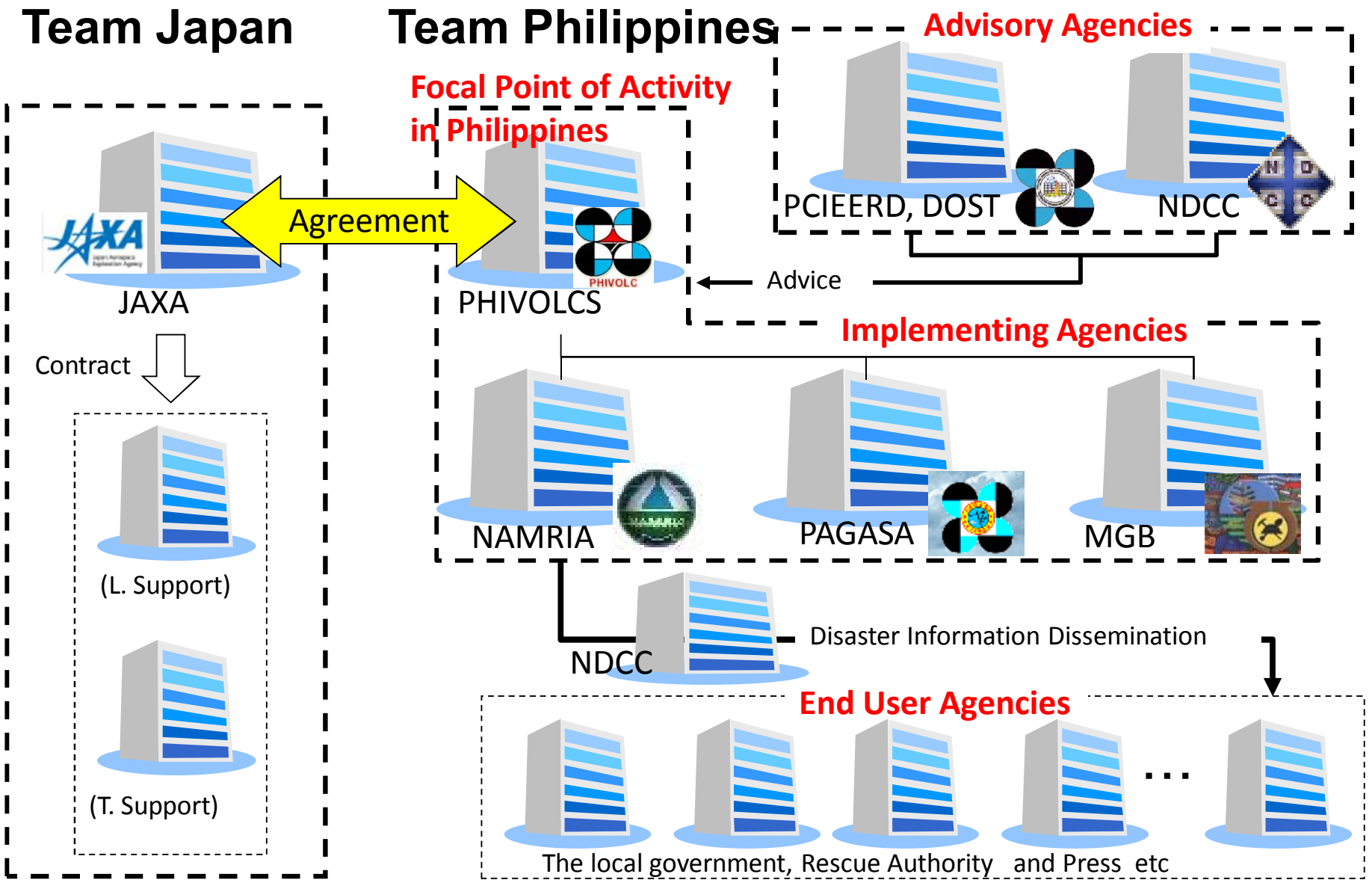
Japan Aerospace Exploration Agency

Sentinel Asia Success Story

- **Regional cooperation** to promote utilization of Sentinel Asia by **end-users**
- Local awareness and knowledge transfer through **capacity building**
- Human resources and human network development

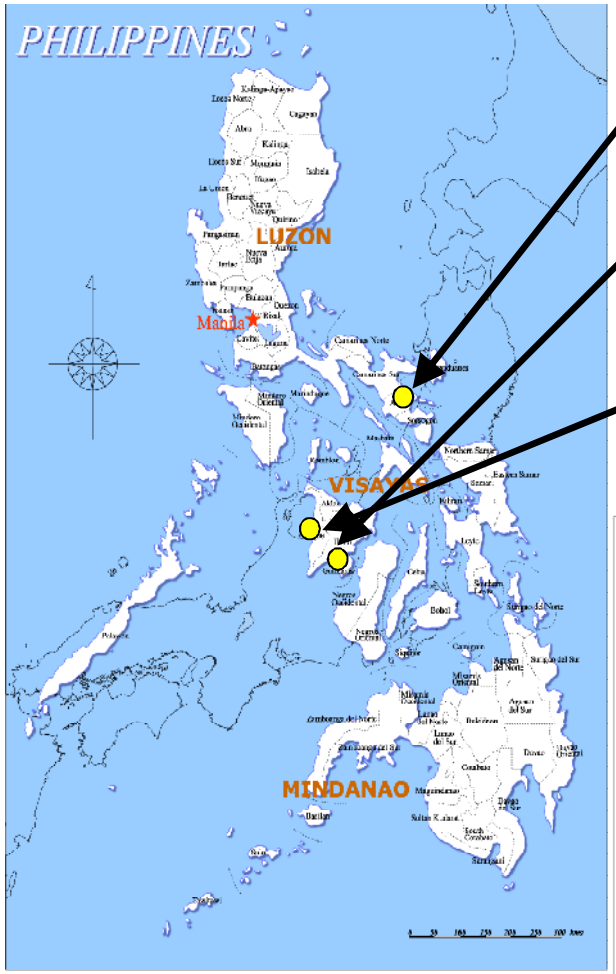
- **Success Story in the Philippines** (PHSS) from 2009
- **Mini-Project** for EO (Emergency Observation) Success Story in Sri Lanka, the Philippines, Bangladesh, Myanmar from 2013 and Indonesia, Vietnam from 2014

Framework of PHSS



1st Phase: 2009-2010

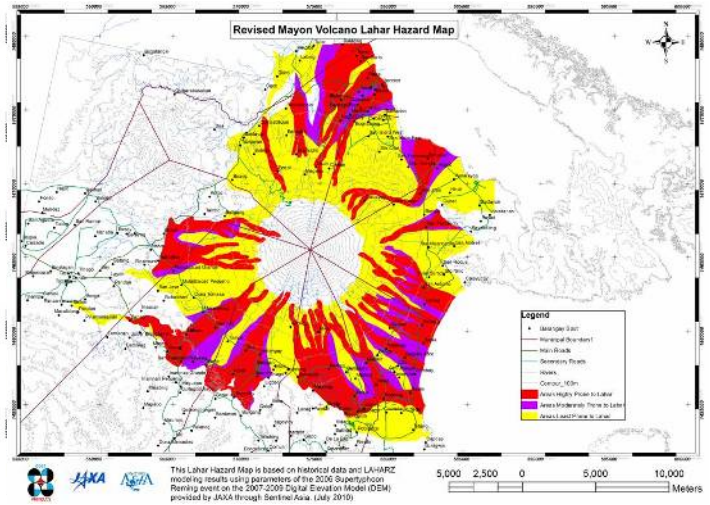
Hazard maps (Flood, Lahar and Landslide) of 3 study areas (Antique, Iloilo and Mt. Mayon) were created by using ALOS Pansharpen Image and DSM.

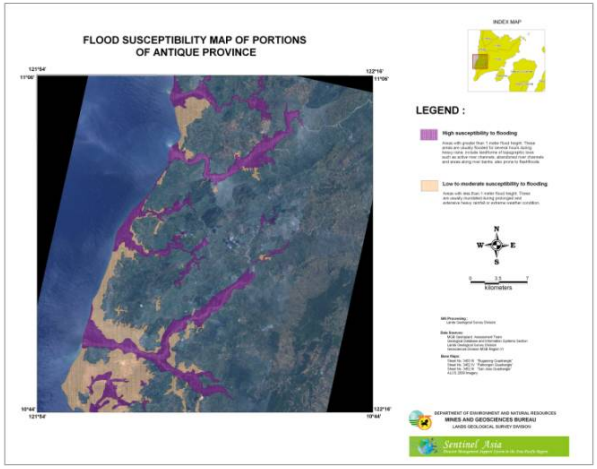


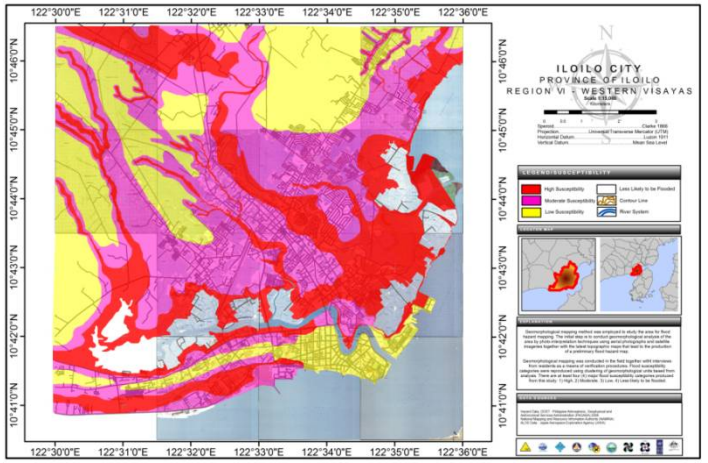
Lahar - Mt. Mayon (PHIVOLCS)

Flood - Iloilo City (PAGASA)

Landslide - Antique (MGB)

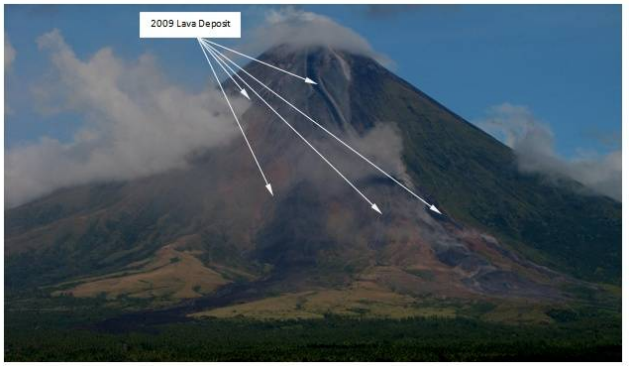




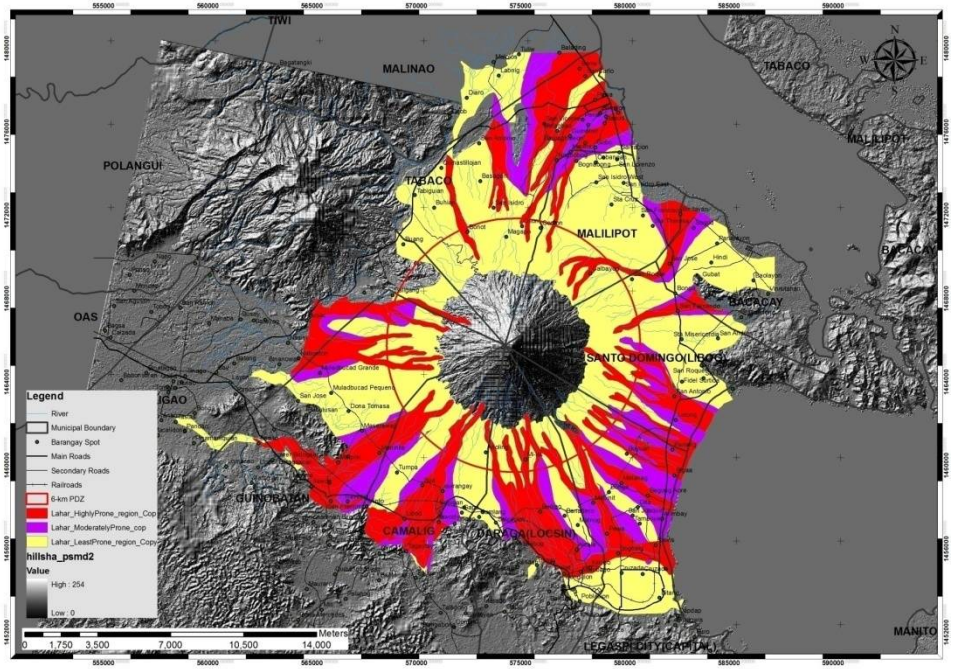


Eruption of Mayon Volcano in the Philippines in December 2009

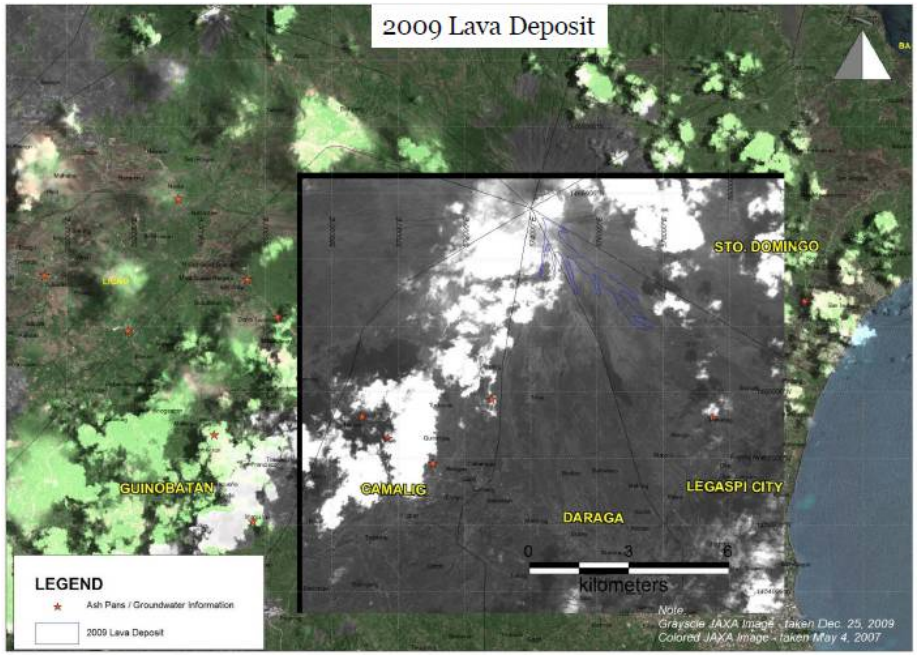
Philippine Institute of Volcanology and Seismology (PHIVOLCS) made lava deposit map by the eruption using ALOS imagery and others, **which was used to understand the situation and make decision** by National Disaster Coordinating Council (NDCC).



Mayon Volcano on 30 December 2009



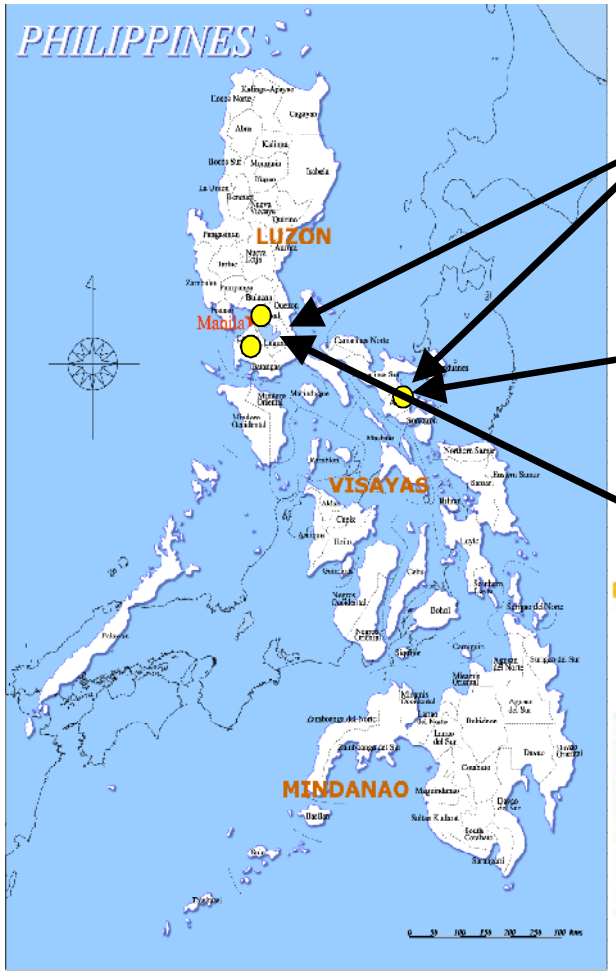
lava flow hazard map made by PHIVOLCS using ALOS DSM



lava deposit map made by PHIVOLCS using emergency observation imagery with ALOS/AVNIR-2 on 25 Dec. 2009

2nd Phase: 2011 - 2014

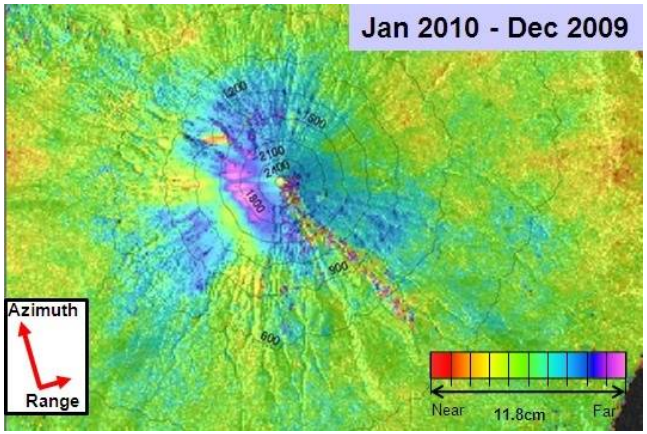
Application of GSMaP for Landslide Warning, and Interferometry for monitoring of Land Subsidence and Earthquake/Volcanic Eruption have been studied.

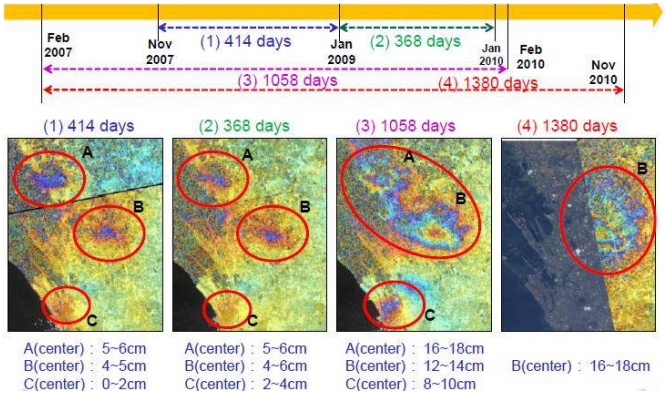


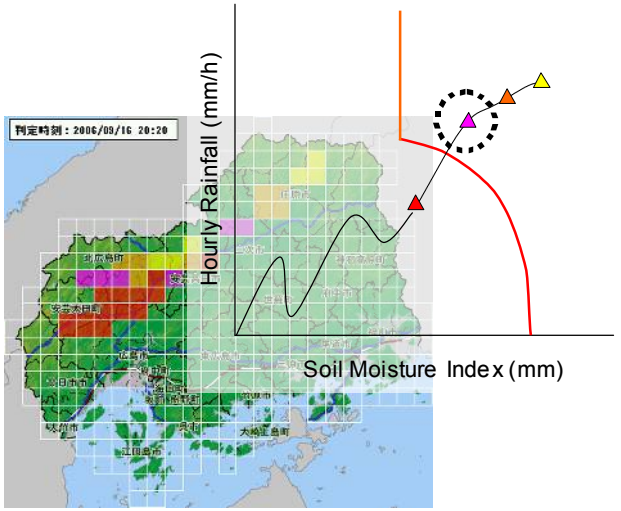
Volcano & Earthquake Monitoring
- Mt. Mayon, Mt. Taal & Valley Fault

Landslide Warning
- Albay

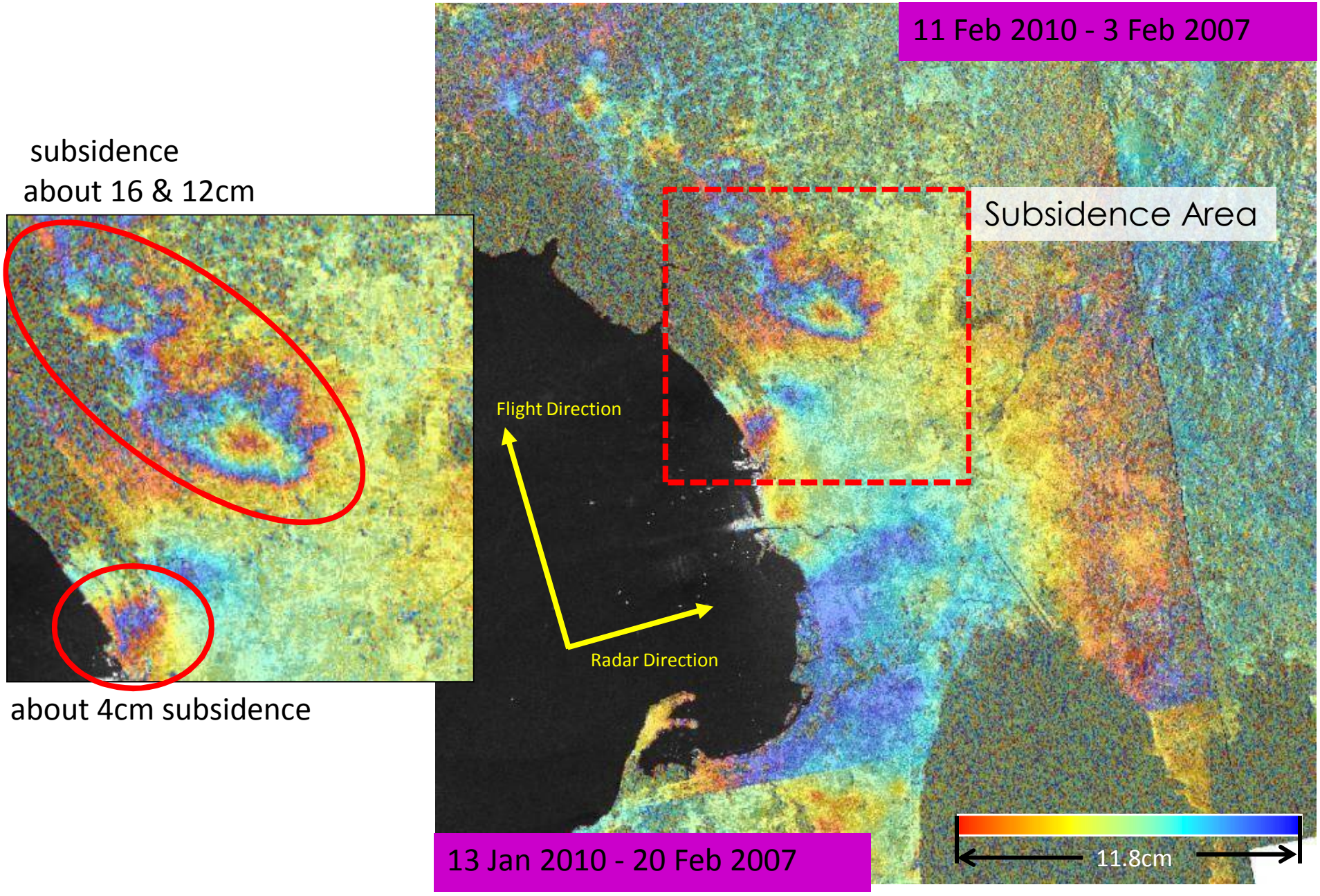
Land Subsidence
- near Manila





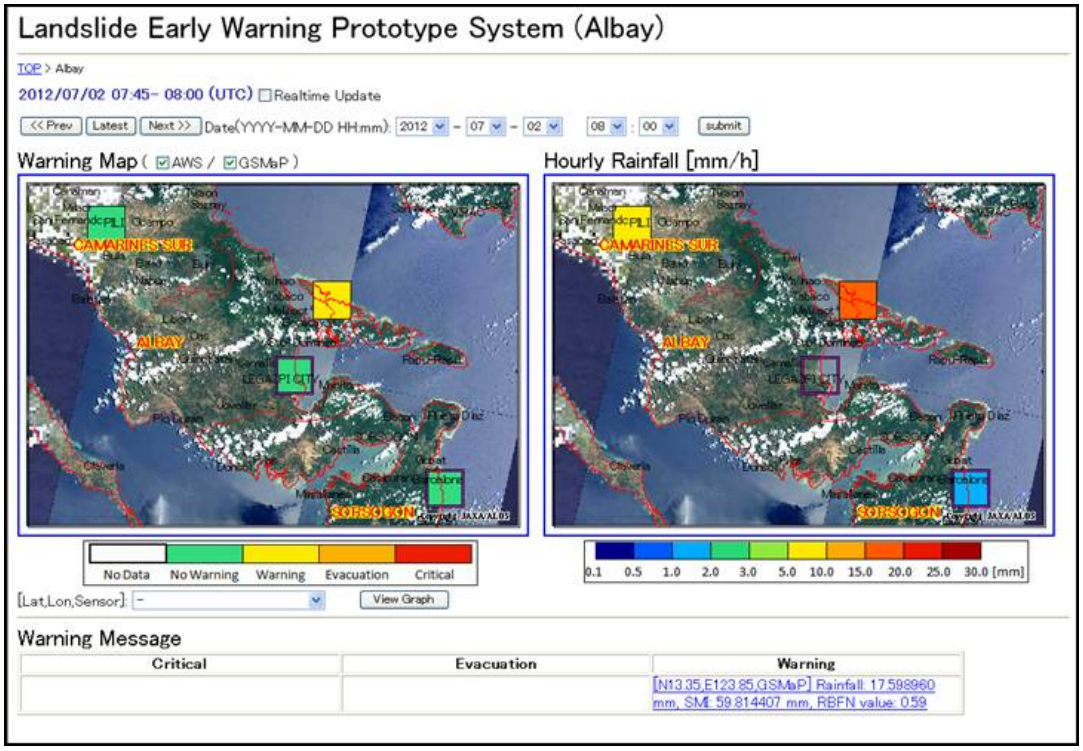


Land Subsidence near Manila (3 years, 2007-2010)

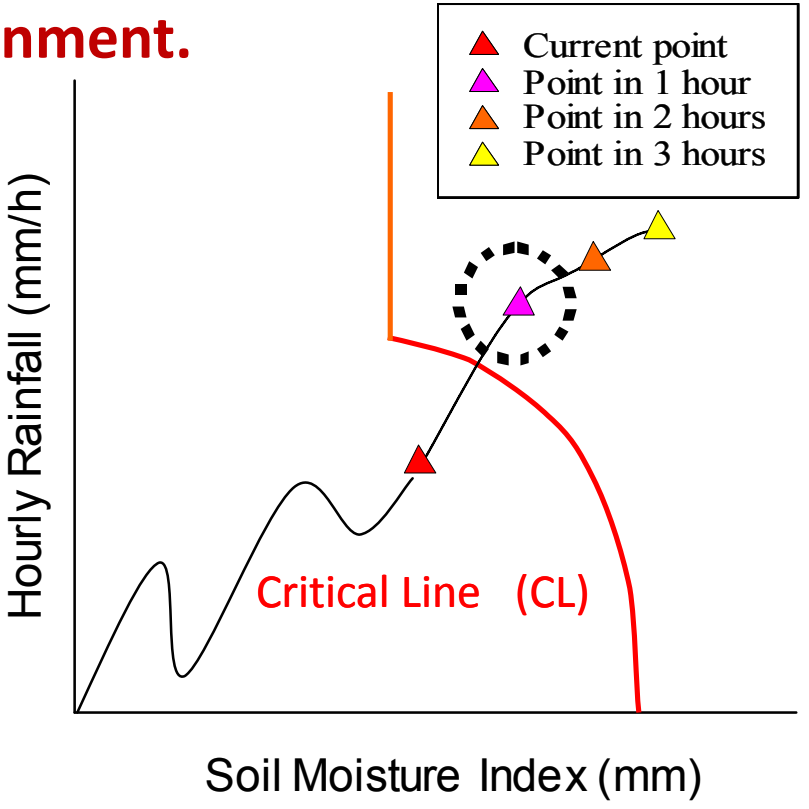


Landslide Forecasting using Critical Line

Early waning for **debris flows and slope failures (short-term events)** is issued based on current (& predicted) rainfall situation and **non-linear CL**. Hourly point of **rainfall vs SWI** is traced on CL, and if it exceeds CL early warning is issued. **This method is applied to early warning by Japanese prefectural government.**



Landslide Early Warning Prototype System in Albay



Y-axis: hourly rainfall (mm/h)
X-axis: soil moisture index (SMI) (mm)

Technical Training

Summary from 2009-2011	Trainings	No. of Participants
2009	Remote Sensing	9 ++
2009	Multi-spectral and Radar Image Processing	22
2010	InSAR Processing	35
2010	Satelitte-based Rainfall Precipitation	34
2011	Differential Interferrometry	27
2011	Landslide Modelling and Warning Using Satellite-based Rainfall Data	28
2014	PInSAR Processing and Landslide Warning System	

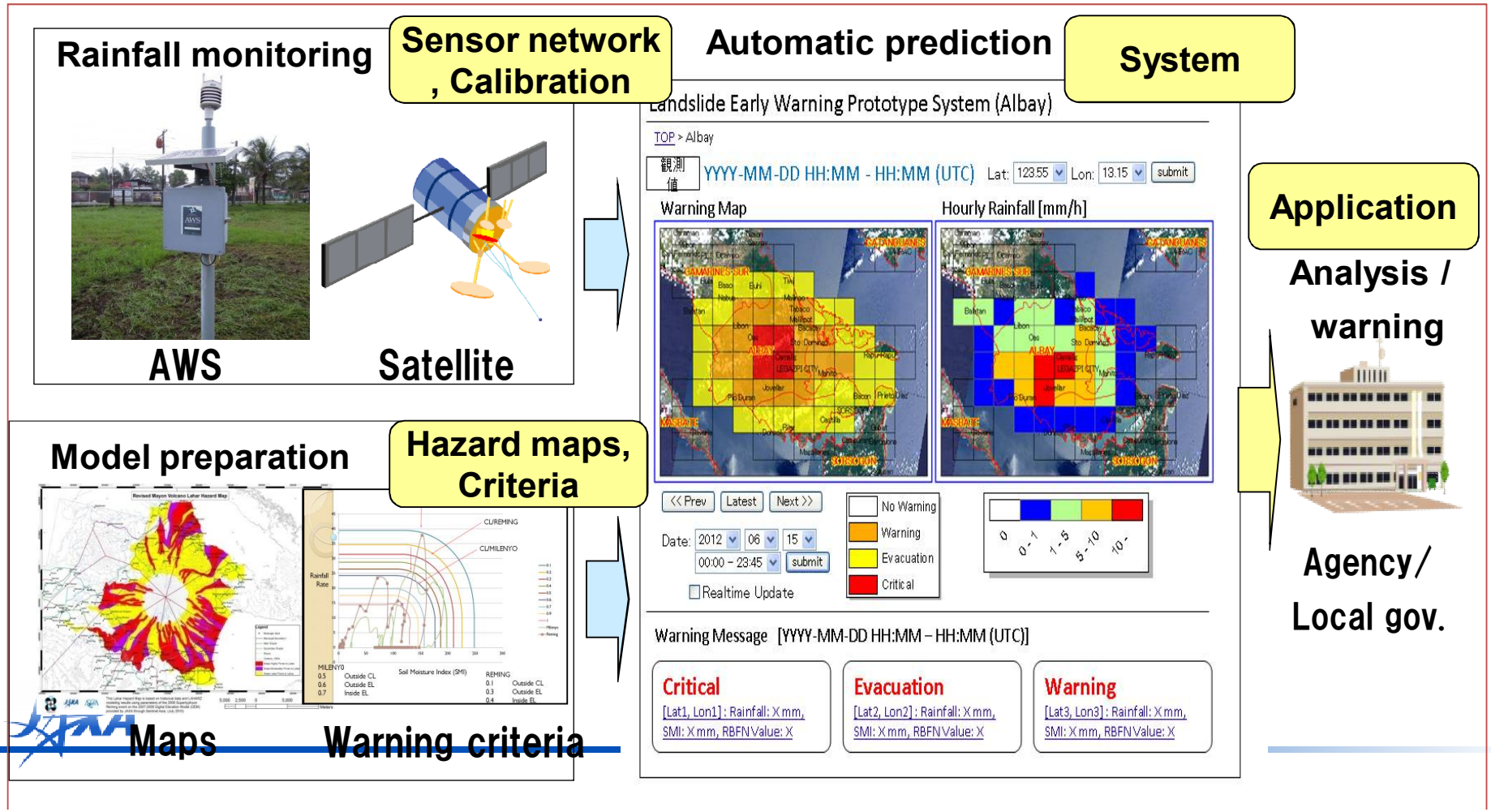
3rd Phase: 2015 -

- ***Landslide Early Warning System in the Philippines***

- *Activities in Sentinel Asia in the Philippines*
- *New Technologies used for the project*
- *Introduction of the activities in 2015*

Concept of the Landslide Warning System

At normal time, landslide prediction model is prepared by the analysis of past rainfall and hazard records using a machine learning method (RBFN). At real-time, rainfall data is monitored by the used of satellite and ground station. When heavy rain-fall happens, landslide warning level is predicted automatically by the prepared prediction model.



Activities for the Landslide Warning System

PAGSA
ASTI

JAXA
Satellite

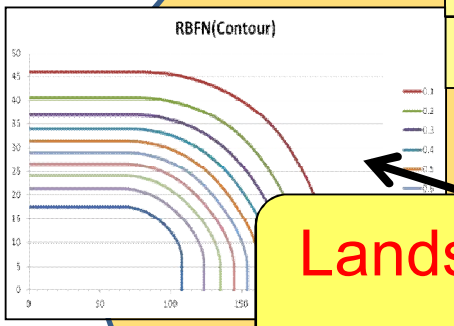
Ground

Rainfall sensor network

Calibration

Local Government
PHIVOLCS
Japan Team

Model

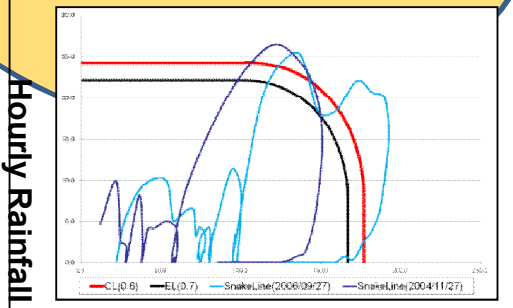


Model definition

Landslide Prediction Modeling

Setting criteria

Historical analysis by RBFN*



Landslide Warning System

Evaluation & Feedback

System operation

Determination

Informed by web/ e-mail

Local Government
PHIVOLCS
Japan Team

RBFN : Radial Basis Function Network
A machine learning method which can determine the risk of landslides from past rainfall records.

Project Activity in 2015

The project consists of three main activities. The state-of-art challenge is the use of space based rainfall monitoring fully combined with ground based sensor networks in real-time.

Key Technologies

Establishment of Rainfall Sensor Network

✓ *Real-time calibration and validation of rainfall by using GSMaP-IF and AWS*

AWS (ASTI/PAGASA) + GSMaP-IF

Modeling of Multi-type Landslide Prediction

- Shallow(Debris-flow) / Deep (Creep) / Lahar

✓ *Calibration and validation of landslide prediction by RBFN and DYNASLOPE model*

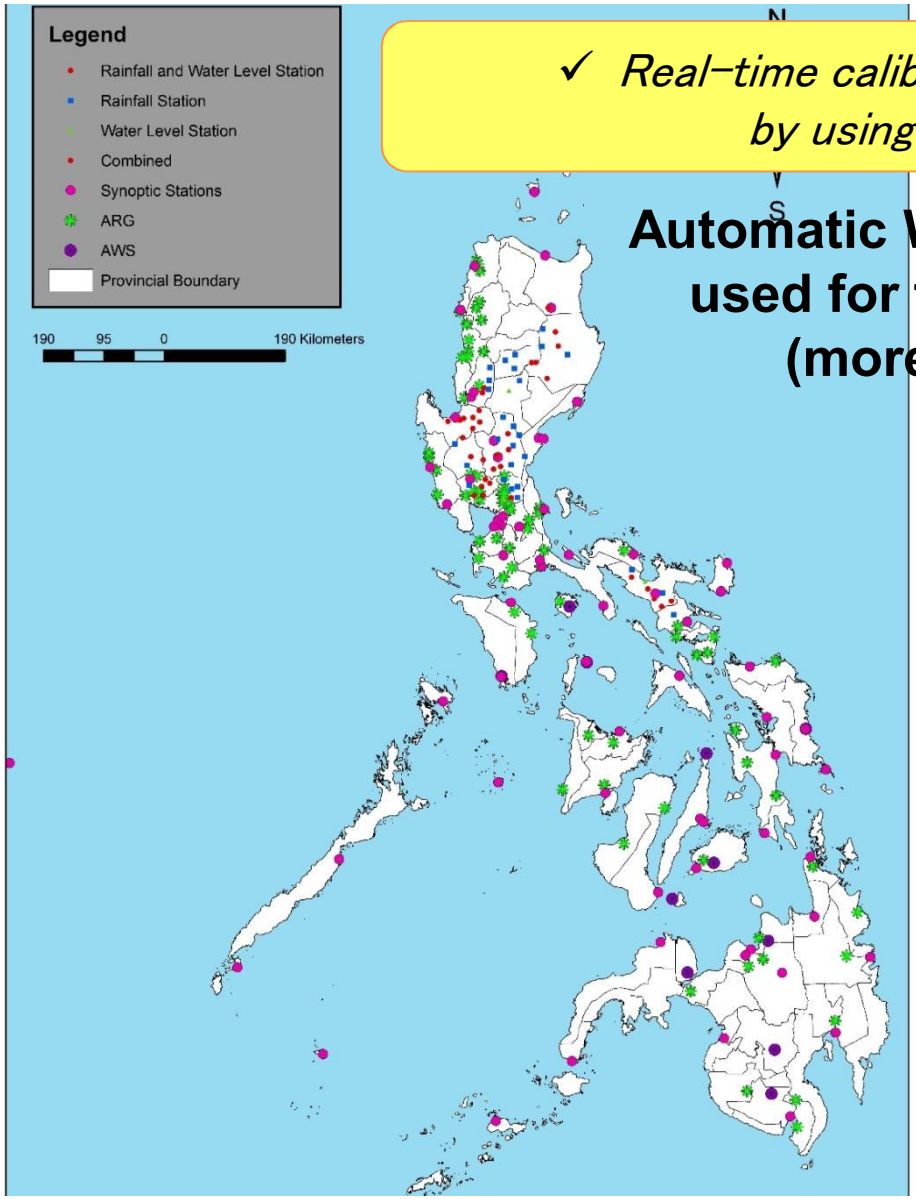
Landslide sensor (DYNASLOPE) + RBFN

Prototyping of Landslide Monitoring System in the Philippines

✓ *Investigation and preparation for the landslide monitoring system.*

Landslide monitoring prototype (Web-based)

Establishment of Rainfall Sensor Network

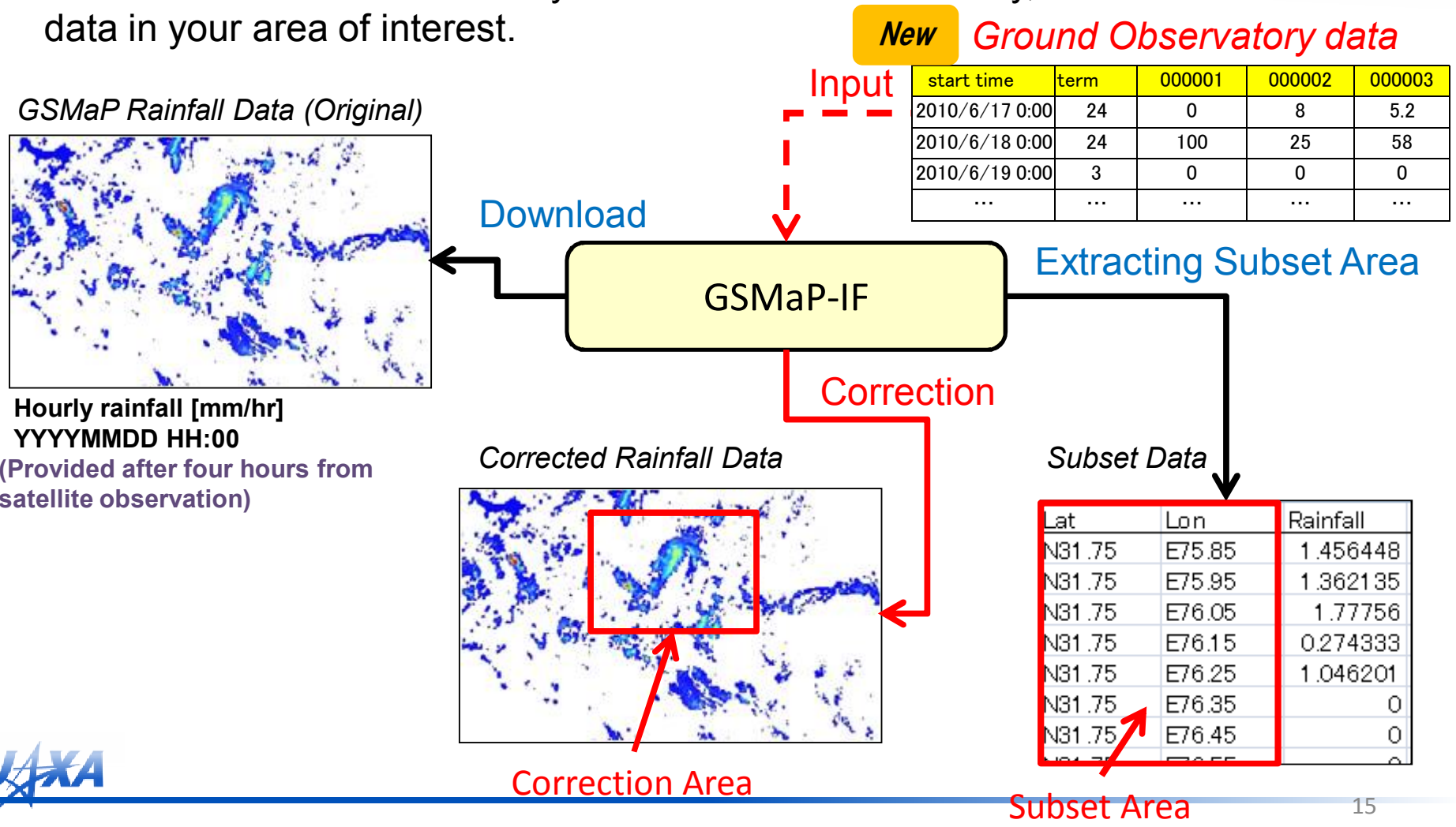


✓ *Real-time calibration and validation of rainfall by using GSMaP-IF and AWS*

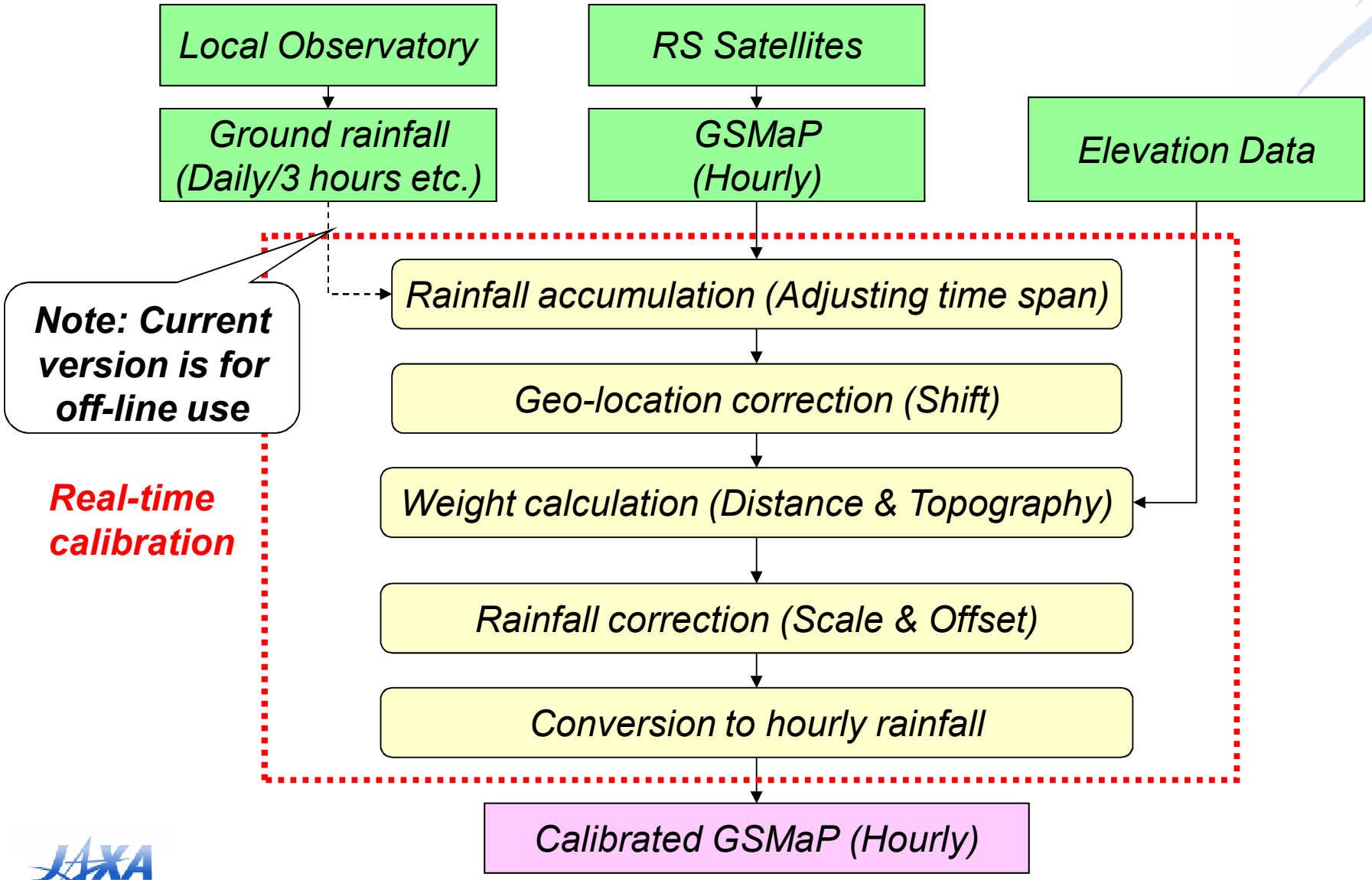
Automatic Weather Sensors used for the calibration (more than 300)

What is “GSMaP-IF”? : Calibration System for GSMaP

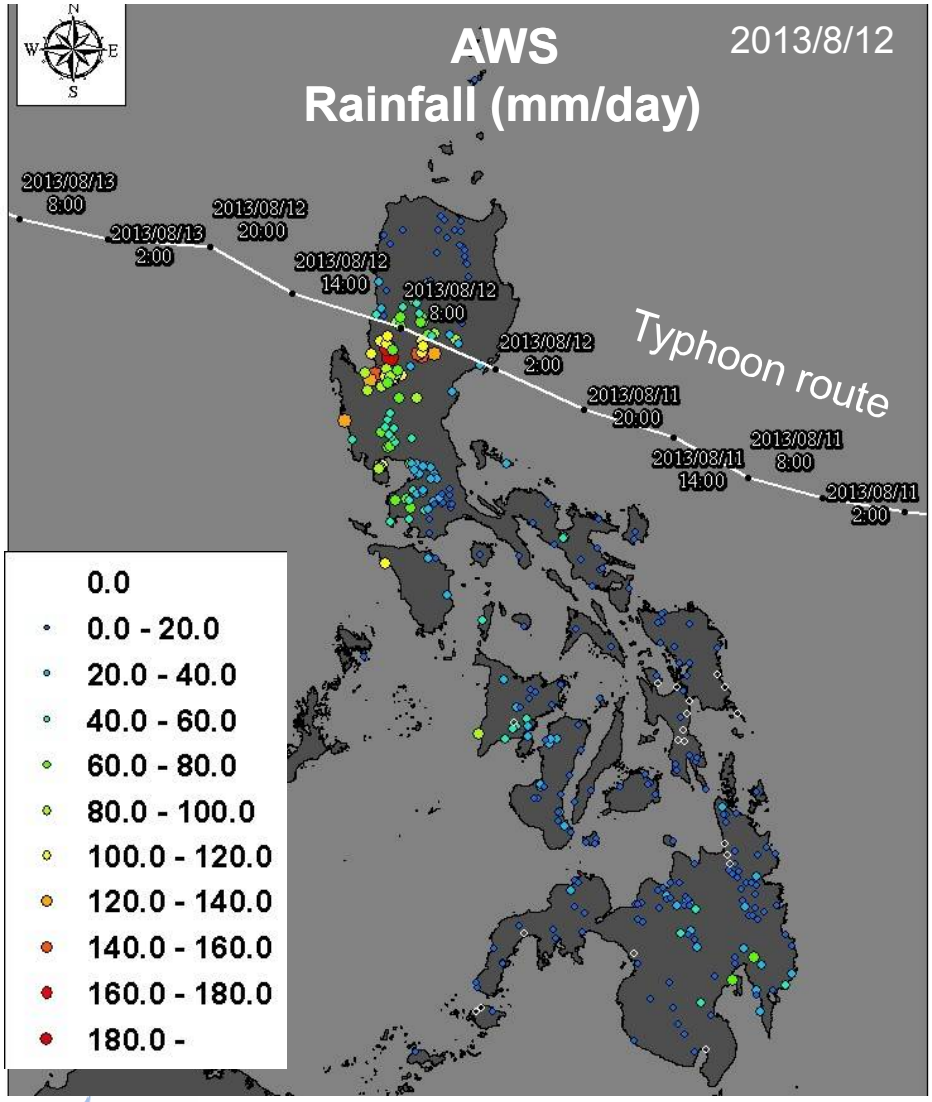
- GSMaP Customization IF (GSMaP-IF) is a software to customize GSMaP, extracting subset area of GSMaP data and correcting the rainfall rate.
- GSMaP-IF downloads hourly GSMaP data automatically, and corrects the data in your area of interest.

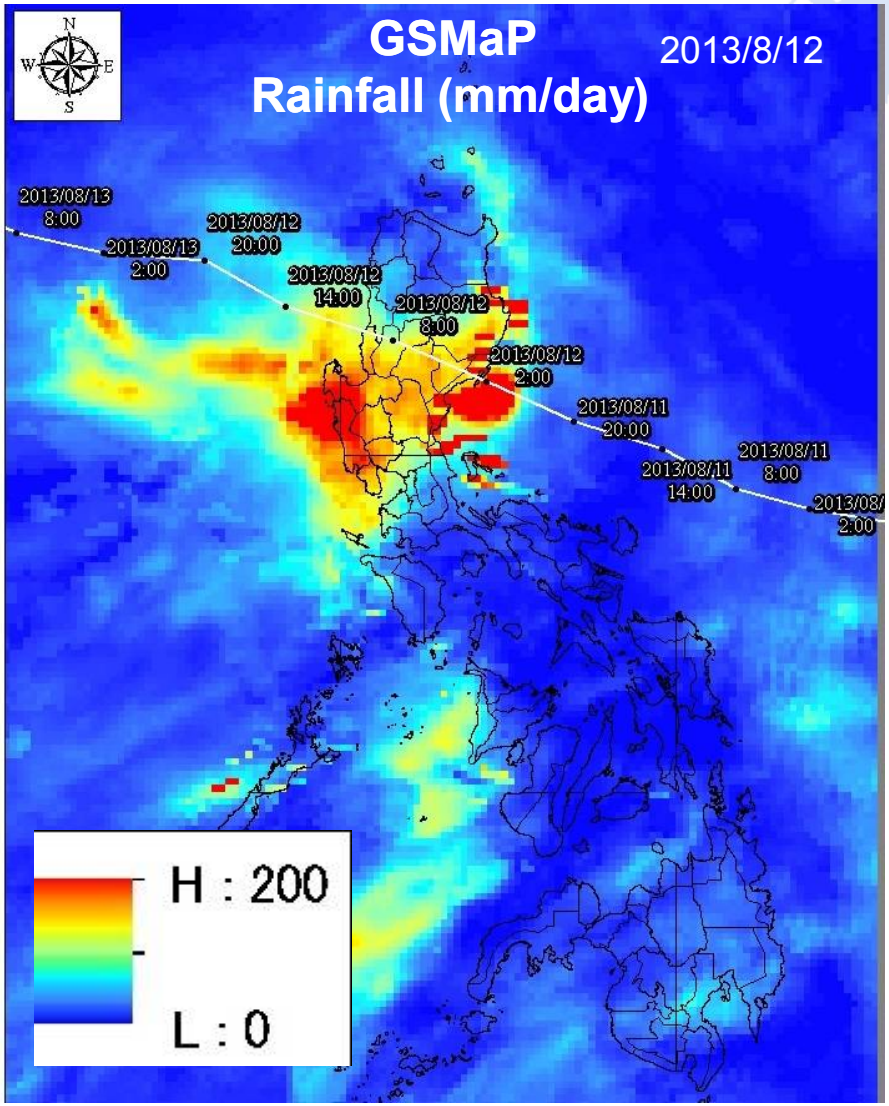


Flow chart of GSMaP real-time calibration



Validation test : Typhoon Utor (Aug. 2013)





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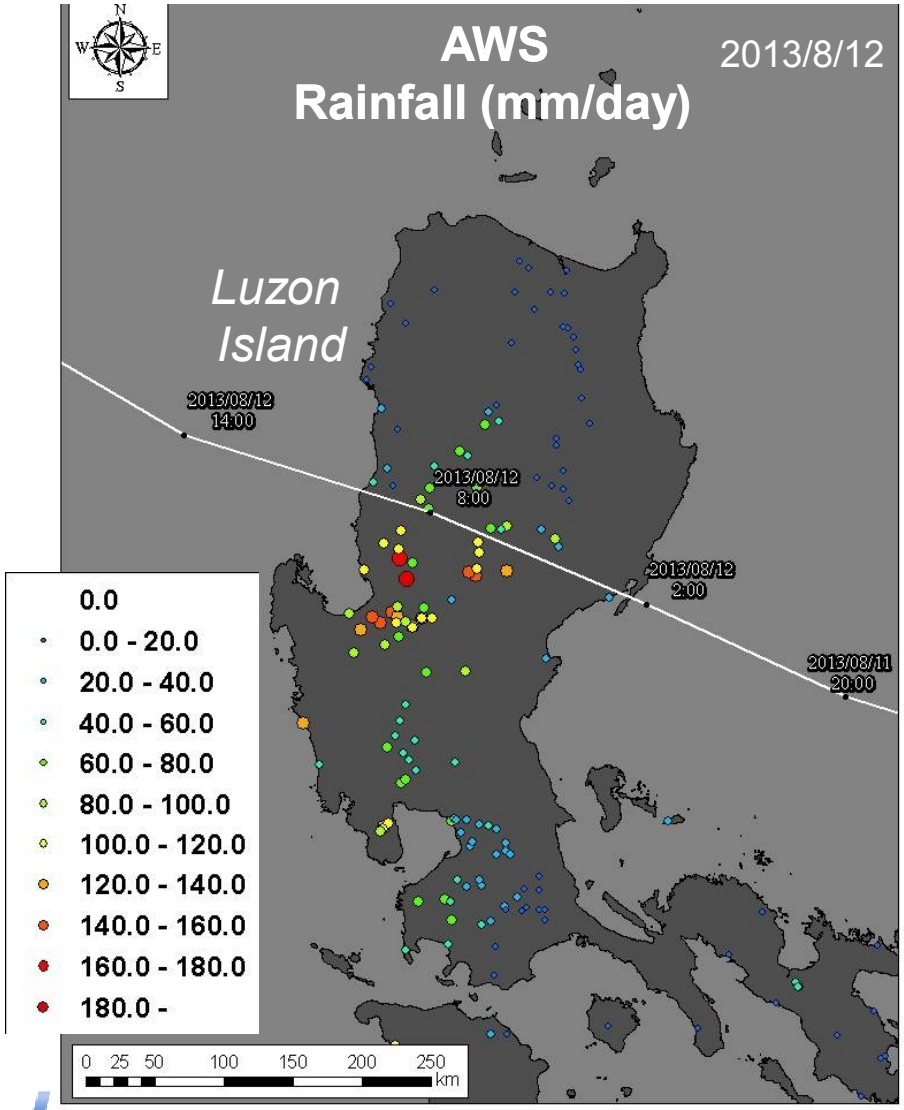
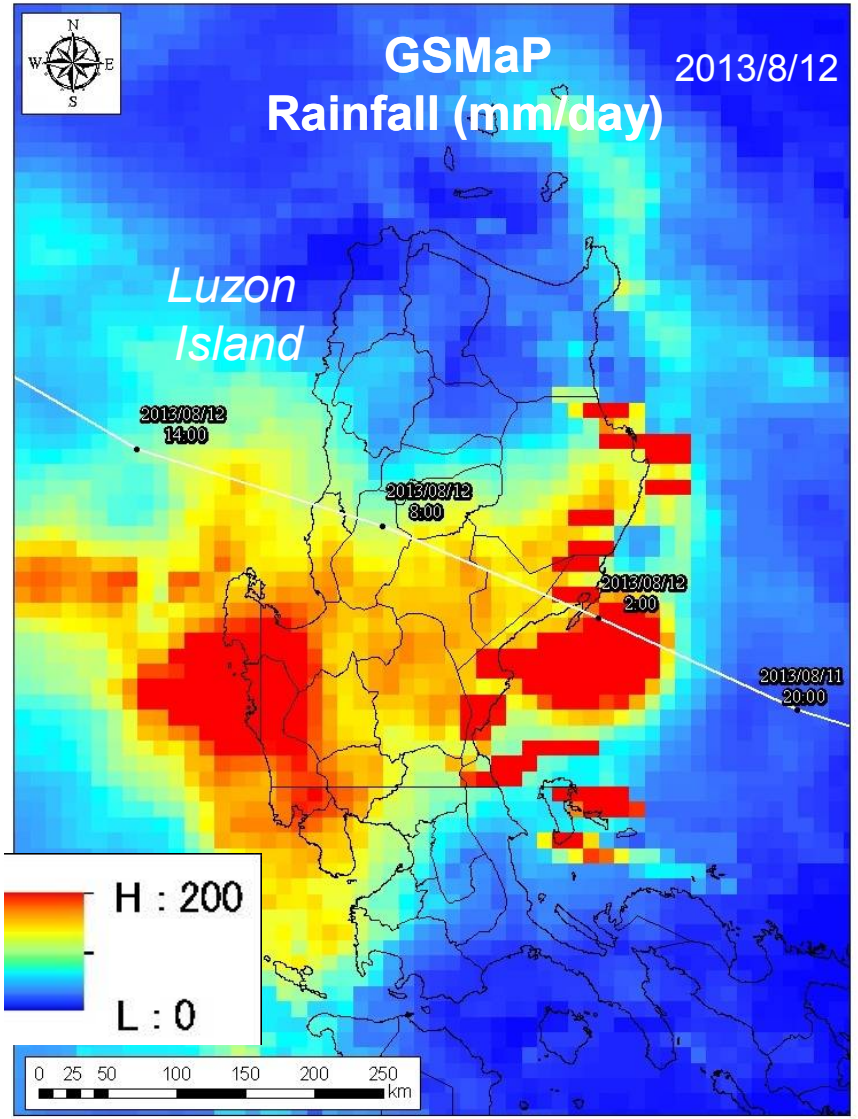
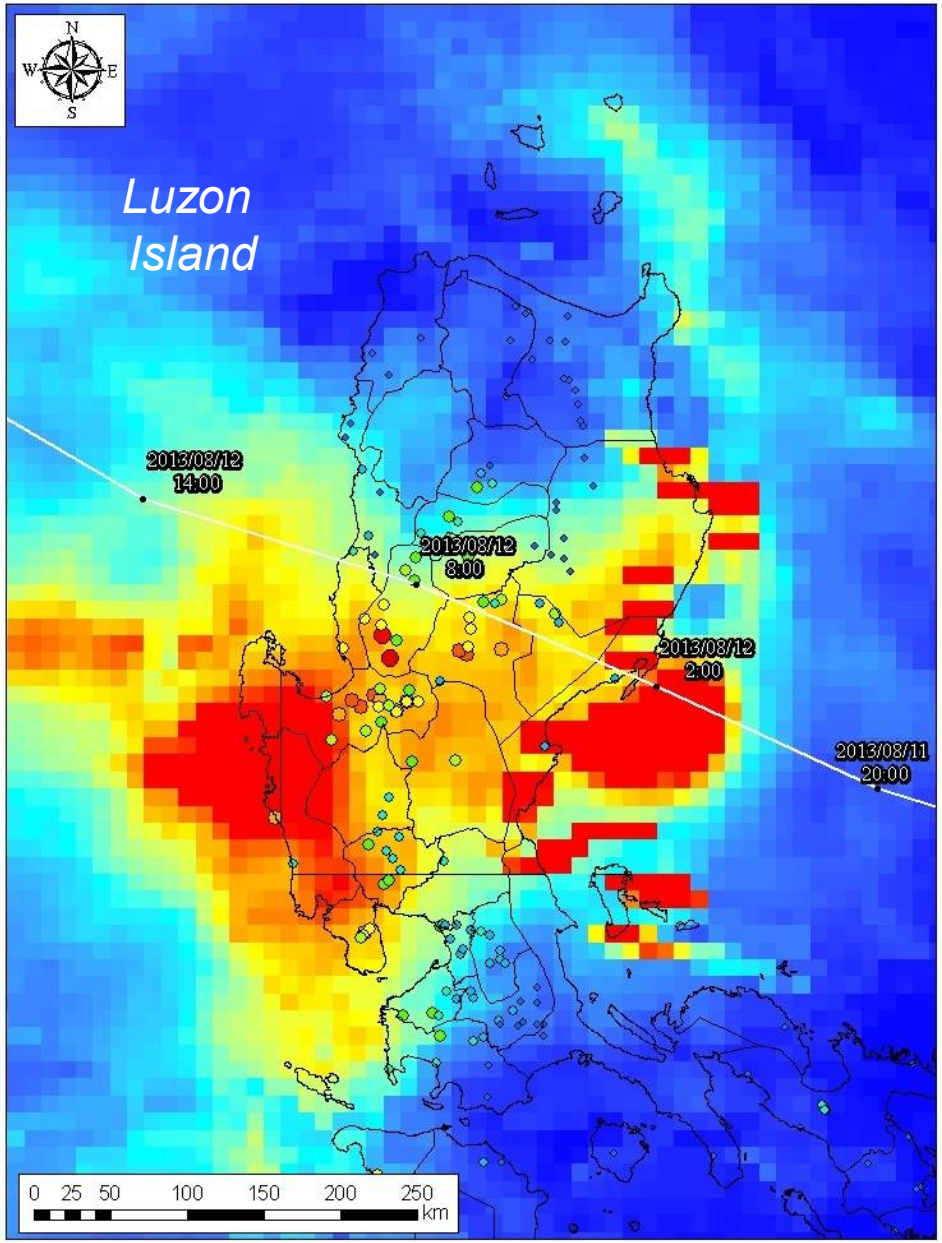
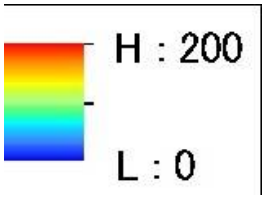




Validation test : Typhoon Utor (Aug. 2013)

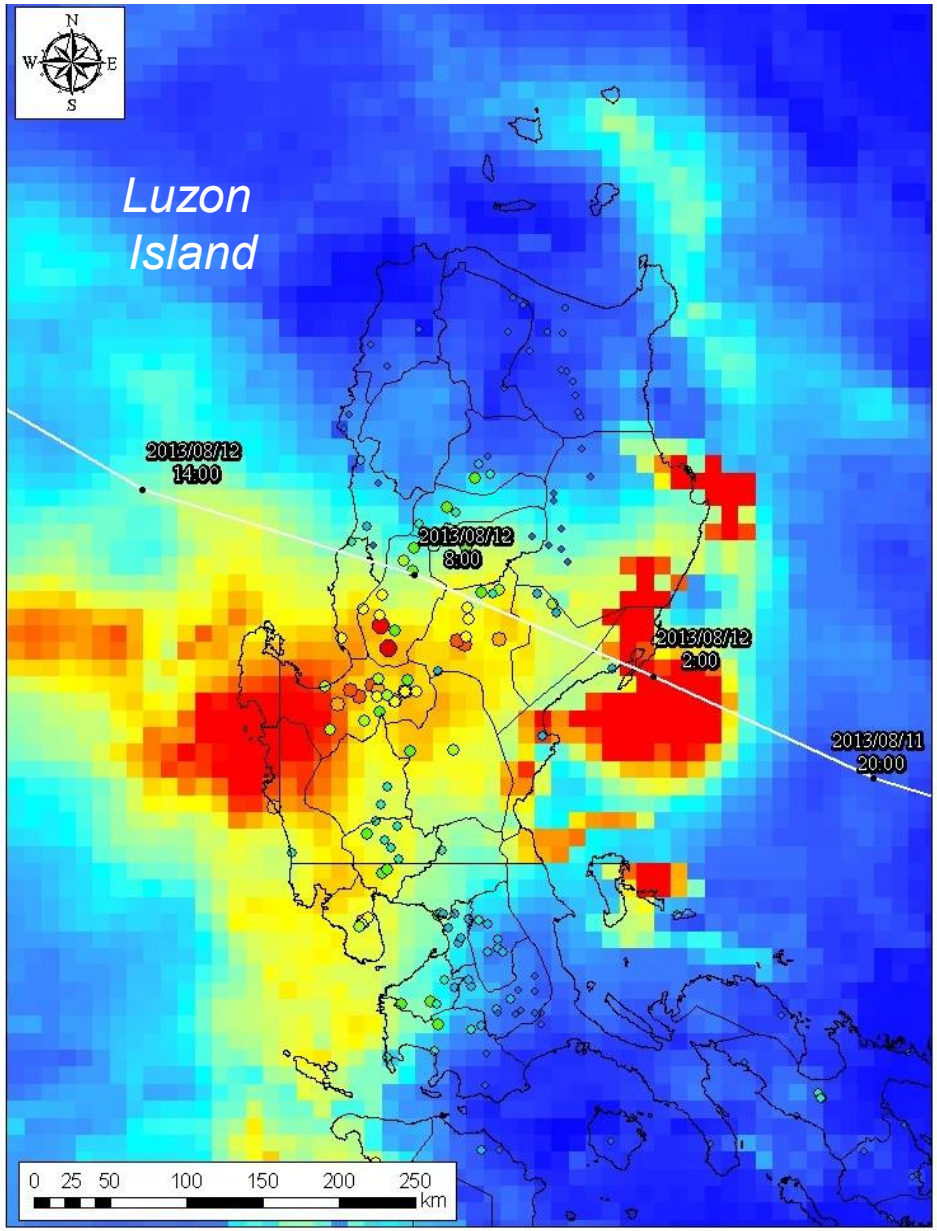
Original GSMaP

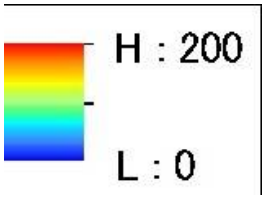




Validation test : Typhoon Utor（Aug. 2013）

Corrected by GSMaP-IF based on AWS





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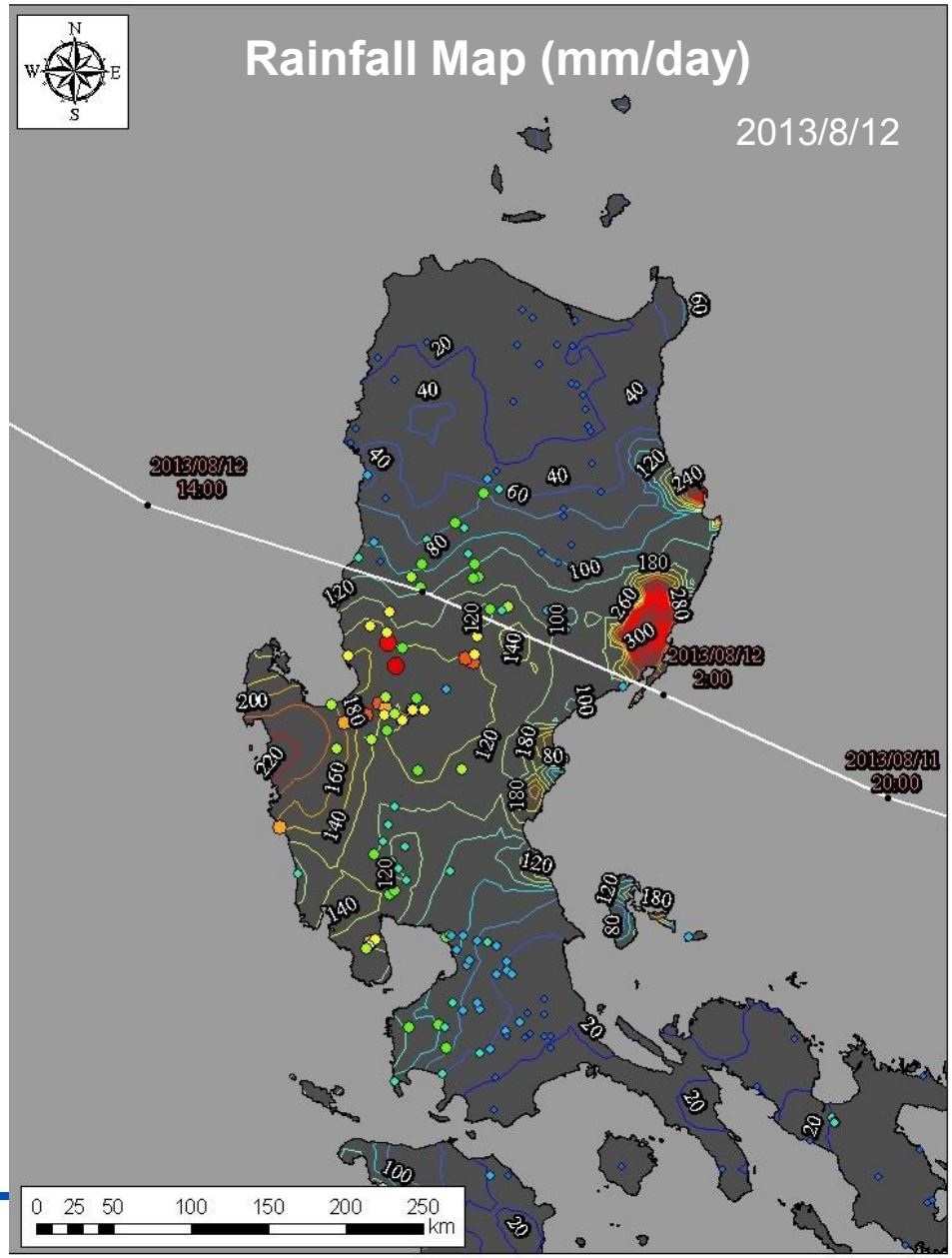
Corrected by GSMaP-IF based on AWS



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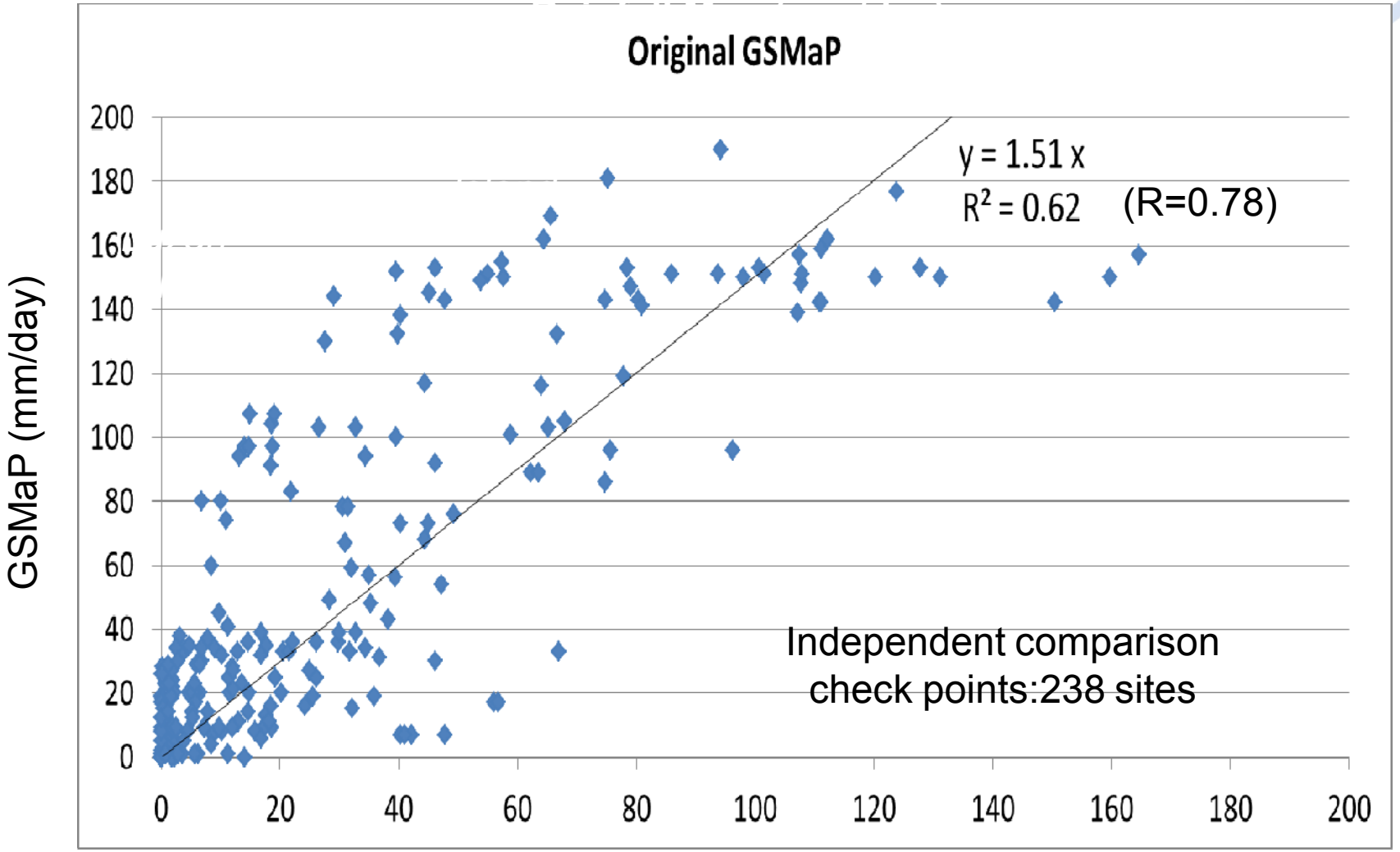
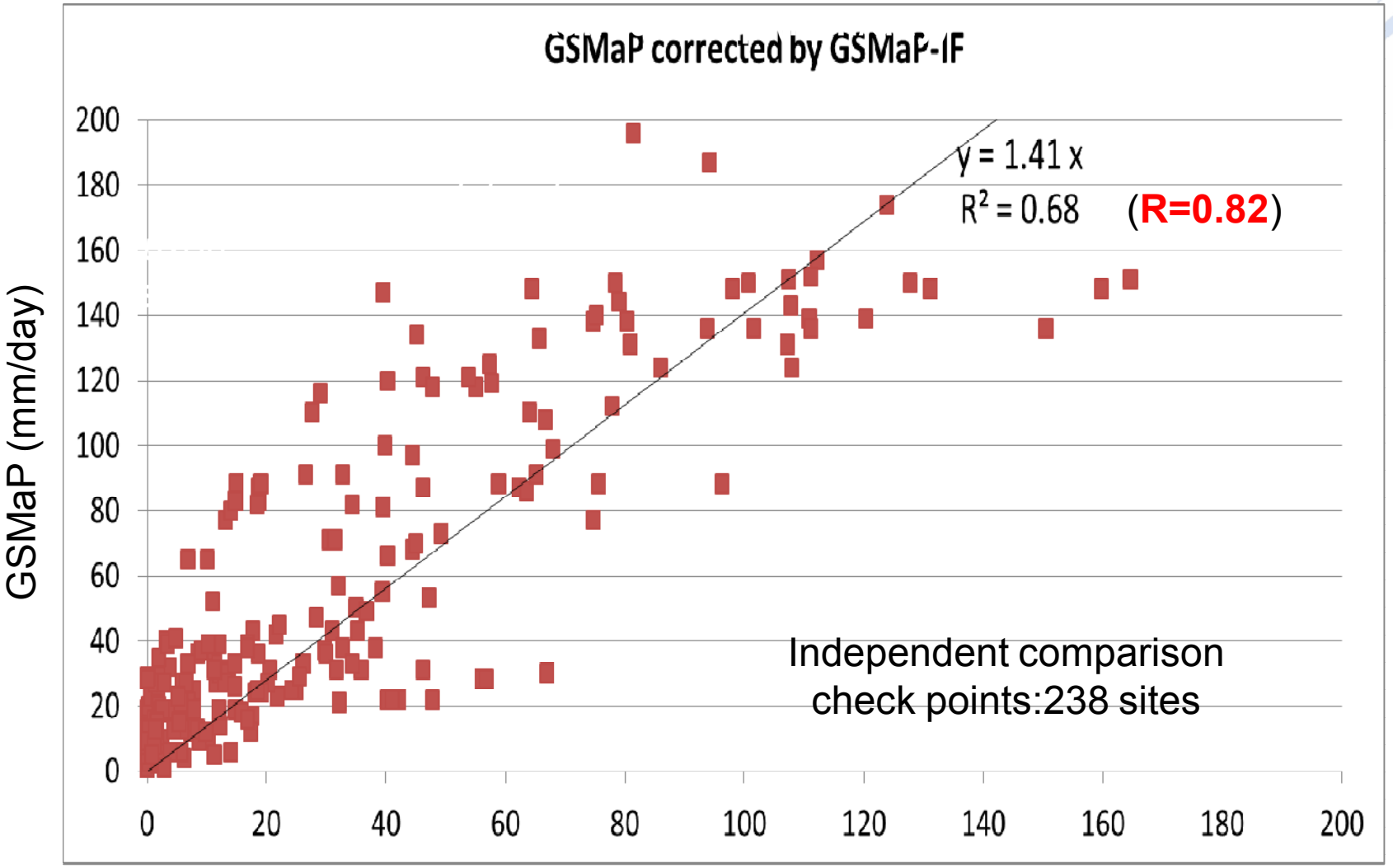


Comparison check between AWS and GSMaP

Validation test : Typhoon Utor (Aug. 2013)



Comparison check between AWS and GSMaP

Modeling of Multi-type Landslide Prediction

Plot all non-occurrence data
(at least a 10year period)

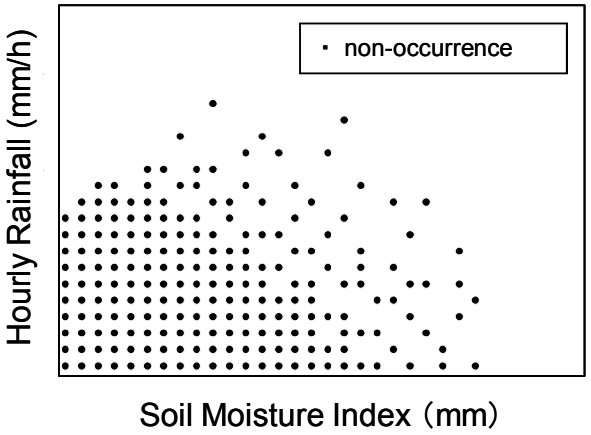
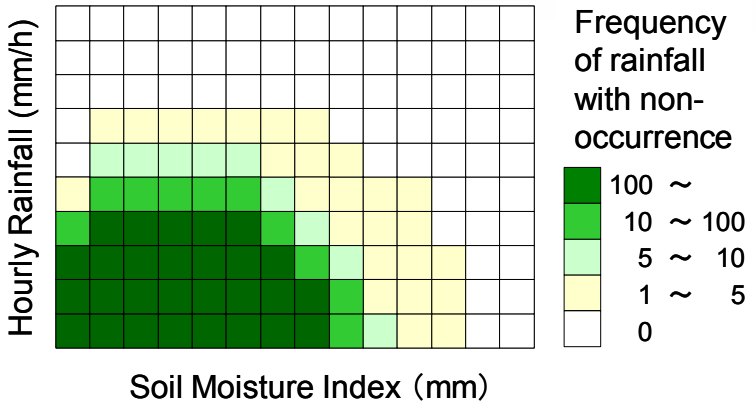
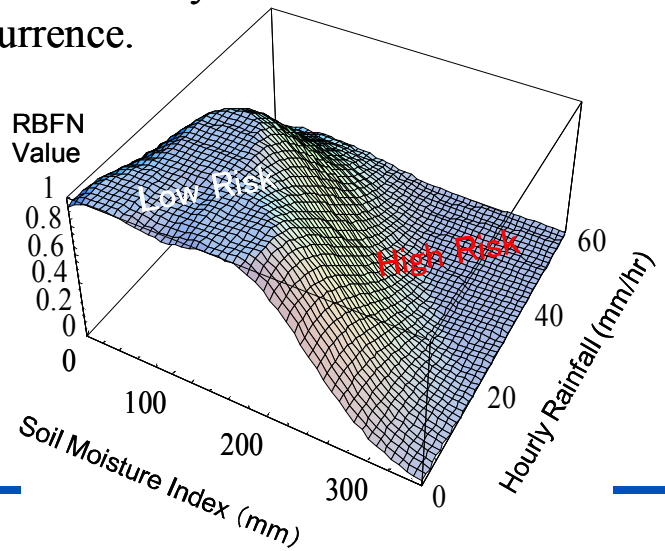


Image of the analysis

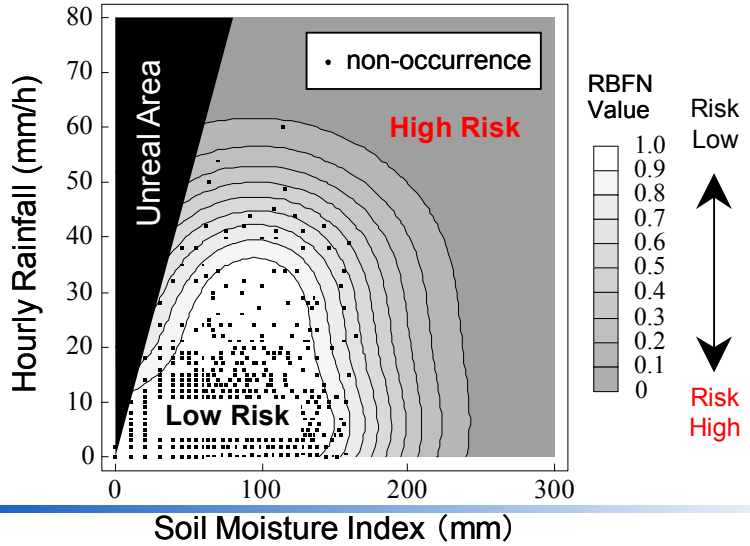
Evaluate the risk based on rainfall frequency



The RBFN value evaluates the reliability of non-occurrence.



Analysis using the RBF Network



Modeling of Multi-type Landslide Prediction

DYNASLOPE PROJECT:
DEEP-SEATED LANDSLIDE WARNING SYSTEM

- 21/22 Landslide sensors online
- 10/10 Automatic weather stations online

Brgy. Lipanto, AWS Installation

Brgy. Bolodbolod AWS Installation

Brgy. Boloc Sensor Maintenance

Landslide Early Warning System

Rainfall Data

GSMaP

Updated every 1 hour

AWS

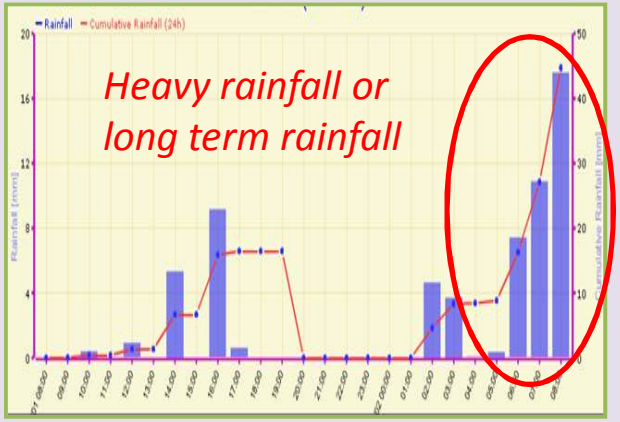
Updated every 15 minute

Input

Landslide Early Warning Prototype System

The system monitors of real-time rainfall data, and analysis using RBFN Models. When monitoring area become landslide danger by rainfall, the system alerts warning message by e-mail.

Rainfall



RBFN Model

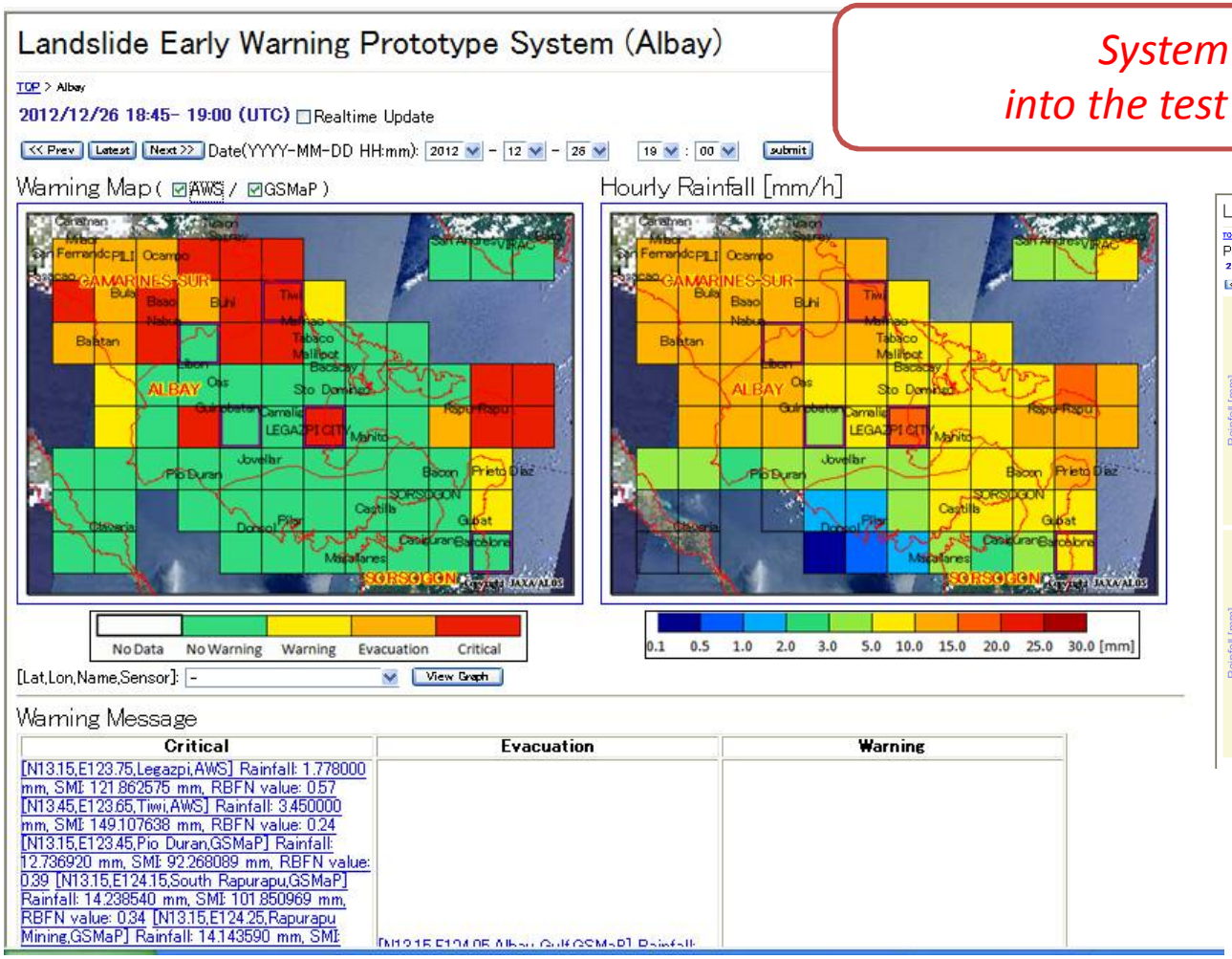
Warning Information

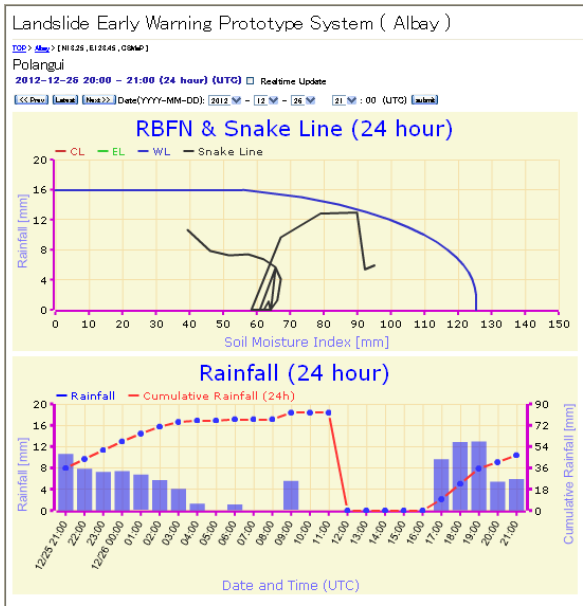
Output

Philippines Team & Japan Team

System operation

System will be installed
into the test site in the Philippines





Project Activities in 2015

- ***Rainfall sensor network***
  GSMaP calibration based on real-time combination with ground monitoring (GSMaP-IF).

- ***Model definition***
  Application to important areas in the Philippines.
  Area selection and technical seminar.

- ***System installation into the Philippines***
  Investigation and preparation for the instllation.
  Operation environment, scheme etc.